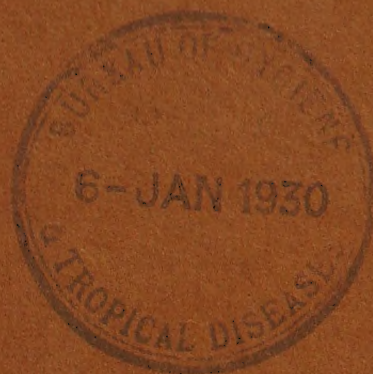




Report on a Visit to Kenya and Uganda to advise on Antimalarial Measures.

By

S. P. JAMES, M.D., D.P.H., I.M.S. (retd.)
Adviser on Tropical Diseases to the Ministry of Health.

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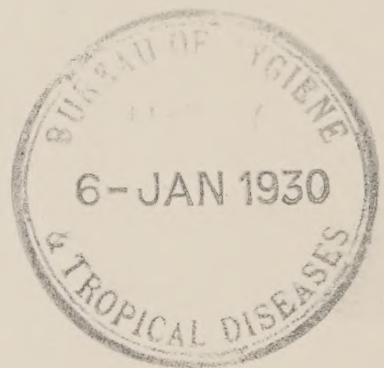
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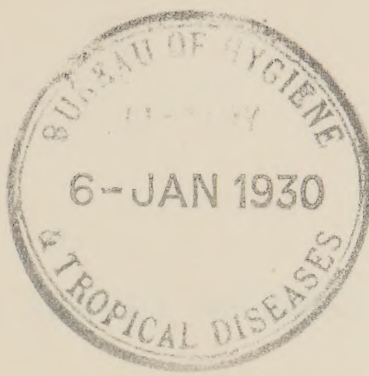


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A*

REPORT

ON A

Visit to Kenya and Uganda to advise on Antimalarial Measures

BY

S. P. JAMES, M.D., D.P.H., I.M.S. (retd.)

Adviser on Tropical Diseases to the Ministry of Health.

I have the honour to submit the following report on my recent visit to Kenya, which was arranged at the request of His Majesty's Secretary of State for the Colonies in a letter dated 9th February, 1929, from the Colonial Office to the Ministry of Health. It was stated in that letter that Mr. Secretary Amery had been in consultation with the Governor of Kenya regarding action to prevent a recurrence of the serious outbreaks of malaria which had been experienced in recent years, and that, although the Kenya Government had taken various measures within the limits imposed by financial considerations and available staff, the disease was still a serious menace. It was added that His Royal Highness the Prince of Wales, in a speech at Nairobi on Armistice Day, 1928, stated his belief that "an intensive and scientifically conducted campaign against malaria in Kenya would accelerate the progress of the Colony a hundredfold," and that the Governor had announced that it was his Government's intention to stamp out the disease.

It was arranged that I should proceed to Kenya forthwith, my instructions being "to advise the Government generally as to the measures that should be taken."

It was also arranged before my departure that I should make a short visit to Uganda, for the purpose, primarily, of advising on the antimalarial action to be taken in Kampala, where projects for water-supply, sewerage and town-planning were in train.

I left London on the 15th March, 1929, and disembarked at Mombasa on the 25th. Between this date and the 29th July, when I disembarked again in England, I was occupied as stated in the annexed itinerary (Appendix 1). On the return journey I spent a day at Tanga and another at Dar-es-Salaam on the invitation of H.E. the Governor of Tanganyika, and from the 26th June to the 9th July in Southern Rhodesia and South Africa for the purpose of comparing conditions on farms in those countries with conditions on farms in Kenya.

In Kenya, Dr. Gilks (Director, Medical and Sanitary Services), Dr. Paterson (Deputy Director, Sanitary Services), Dr. Kauntze (Deputy Director, Laboratory Services), Mr. Symes (Senior Medical Entomologist), Mr. Bennett (Antimalarial Engineer) and other officers whom Dr. Gilks deputed from time to time to assist me, did everything possible to facilitate my work and to make my journeys through the country easy and successful; in Uganda I received the same cordial welcome and personal guidance and help from Dr. Chell (Acting Director, Medical and Sanitary Services), Dr. Duke (Deputy Director, Laboratory Services), Mr. Hancock (Agricultural Entomologist, whose services were kindly placed temporarily at our disposal by the Director of the Department of Agriculture) and other officers.

Sir Jacob Barth (Acting Governor of Kenya), Sir William Gowers (Governor of Uganda) and Sir Donald Cameron (Governor of Tanganyika) were each of them so good as to interest themselves personally in my work and to discuss it with me on several occasions: and at Nairobi on the 1st June I was invited to attend a meeting of the Governors and Sir Samuel Wilson, at which the subject of arrangements for Medical Research in East Africa as a whole was to be discussed. For this meeting I prepared a memorandum entitled "A suggestion concerning arrangements for Medical Research in East Africa." I take leave to annex a copy. (Appendix 2).

In the first week of May, on the invitation of the Director of Medical and Sanitary Services, I prepared and delivered at Nairobi an address on "Malaria in Kenya" to members of the local branch of the British Medical Association. My remarks and a summary of the subsequent discussion, in which many members took part, were printed in the "Kenya and East African Medical Journal" for July, 1929, page 92.

I took occasion, as often as possible, to learn the views of members of the Legislative Assembly, settlers, traders, bankers, and other prominent members of the official and non-official community in Kenya, on malaria and closely allied subjects; and at Kitale on the 27th May and again at Eldoret on the 30th I accepted invitations to attend and to speak at official meetings of District Committees at which the subject of antimalarial measures in those towns and districts was discussed. I have utilised in this report some of the information which was brought to my notice during those interviews and meetings.

Before leaving Kenya I prepared, for the personal information of the Director of Medical and Sanitary Services, a brief provisional note on the chief impressions which I gathered during my tour and the advice which I proposed to give in the present report.

Also before my departure, the Director of Medical and Sanitary Services drew my attention to a Government document entitled "Summary of Closer Settlement Proposals, 1928," and requested me to state my opinion of the measures which ought to be taken to safeguard settlers of these classes from malaria and other tropical

diseases. In the present report I have embodied the provisional note on this subject which I prepared on 4th June for his use.

I regret that owing to the shortness of my deputation I could not find time to study malarial conditions in Mombasa and the Coastal Belt. Except to record my impressions on a day's visit to the Digo District, I have not dealt with that area in my report.

In Uganda, at the request of the Chief Secretary to Government, I prepared, on the conclusion of my first visit at the end of April, a note on the preliminary action which I considered should be taken relative to antimalarial measures in Kampala. For my second visit, which was during the first fortnight of June, the Governments of Uganda and Kenya kindly arranged, at my request, that I should be accompanied by Mr. Bennett, the expert antimalarial engineer from Malaya, who is at present conducting antimalarial drainage work in Nairobi, and by Mr. Hopkins, the junior Medical Entomologist, Kenya, who was to be appointed Medical Entomologist, Uganda. Mr. Bennett, after a thorough examination of Kampala in company with officers of the Departments of Public Works and of Forests, confirmed and extended the recommendation made in my preliminary note on the subject of planting eucalyptus trees as a substitute for subsoil drainage, and prepared a complete report on "The antimalarial drainage of Kampala municipality," which was afterwards forwarded to the Government of Uganda by the Director of Public Works, Kenya. A copy is included in this report (page 38). Mr. Hopkins took over from Mr. Hancock the duties for which the latter officer had kindly been lent by the Agricultural Department. The presence of Mr. Bennett and Mr. Hopkins in Kampala freed me from the necessity of remaining there during the whole period of my second visit to Uganda and I therefore took the opportunity to proceed on a tour through the malarious areas of the Eastern Province. Dr. Chell (Acting Director, Medical and Sanitary Services) very kindly conducted me on this tour which enabled me to obtain an idea of the immense areas of swamp-land in that part of the Protectorate and the serious amount of malaria which prevails there. Notes on these points will be found later in this report.

To all who have been named and to many others I am under heavy obligation for the opportunities of obtaining information which were everywhere freely provided for me.

II.—RECOMMENDATIONS.

The technical information collected during my tour will be published in the "Kenya and East African Medical Journal" in articles written in collaboration with Dr. Kauntze (Deputy Director of Laboratory Services, Kenya), Mr. Symes (Senior Entomologist) and other officers who accompanied and assisted me throughout my visit. It only remains for me now to give my advice on the antimalarial measures that should be taken, noting at the same time the grounds on which my recommendations are based.

KENYA.

My first recommendation is that in Kenya a new organisation should be created for the purpose of assisting the medical authorities to put into effect the antimalarial policy and action advised in this report and of continuing and extending the various lines of research in the field and laboratory which were begun during my visit.

The organisation should consist of a small permanent group of workers additional to existing medical, sanitary, laboratory, engineering or other technical staff.

It should comprise :—

- 2 medical research officers,
- 1 medical entomologist,
- 1 antimalarial engineer,
- 1 European laboratory assistant,
- 1 European entomological assistant,
- a sufficient subordinate African staff.

The group as a whole should constitute a new section of the existing Division of Laboratory Services for which the D.D.L.S. is responsible under the Director of Medical and Sanitary Services; but in order that it may be clear to all concerned that the formation of the Section is a new departure (and is not simply the addition of a few new appointments to the existing sections of bacteriology, protozoology, entomology, etc.), I suggest that the new Section be named officially “ The Malaria Survey of Kenya.”

The group as a whole will be co-equal with the other principal sections (e.g., Bacteriology) of the Division of Laboratory Services for the purposes of laboratory accommodation in any existing or future Medical Research Institute and for the purposes of administration; but it will be necessary to make a special arrangement for the Anti-malarial Engineer. This officer, for all purposes, and particularly to ensure intimate liaison and effective assistance, should be under the Director of Public Works, Kenya, and should have his office and workrooms in that official's Department. There is no valid objection to this arrangement, and, in practice, its advantages would immediately become manifest.

All members of the group should be appointed to devote their whole time to malaria, and, at least the superior European staff, should, from the beginning, be officers who are expertly qualified in the several specialised branches of the subject. I shall describe, in a later paragraph, the plan which I recommend for enabling this essential requirement to be fulfilled.

Reasons for this recommendation.—The decision of the Kenya Government to adopt the high aim in antimalarial work which is stated in the letter from the Colonial Office to the Ministry of Health already quoted, is entirely acceptable and wholly welcome, but I should be doing less than my duty if I failed to indicate that the campaign will be long and difficult and that adequate preparations

for its direction and conduct must be made. We must accept and follow the principle laid down by H.R.H. the Prince of Wales that the campaign requires to be conducted "intensively and scientifically" and, to the degree that we are able to convince the authorities that what we think should be done is reasonable and practicable, we must endeavour to get them to extend the present "limits imposed by financial considerations and the staff available." On this point I should perhaps explain that the preparations necessary in a country which adopts the high aim that Kenya has adopted, differ in kind and degree from the arrangements that are often considered to suffice in countries which are content with a lesser result. The outstanding difference is that while in the latter case the little that is desired may sometimes (but not often) be accomplished with the aid of existing technical services, it is essential, in the former case, to create an additional organisation which is appointed exclusively for the purpose in hand and consists of technicians who are expertly qualified in the several specialised branches of the subject and who will devote their whole time to the task.

There are other important reasons. For example, those who read what will be said later in this report and in technical articles, cannot fail to be left with the disquieting impression that the amount of malaria in Kenya as a whole is serious—more serious perhaps than is indicated by figures of infection rates collected during a healthy year at the end of a long period of drought. We can say from available figures that of the total population of Kenya at least a million persons (probably many more) are constantly suffering from malaria and we know that at present hardly 1 in 60,000 of these people is within reach of a medical practitioner. Secondly, no one who is endeavouring to find a practicable solution of the malaria problem in the world generally, can forget some unpleasant truths which have slowly emerged during the three decades that have passed since the discovery of the mosquito cycle of the malaria parasite. One of them is that no simple method of dealing with malaria has been discovered; another (which is a consequence of the first) is that the history of special "antimalarial campaigns" in the world generally is chiefly a record of exaggerated expectations followed sooner or later by disappointment and abandonment of the work; a third is that, in every malarious country separately, an immense amount of patient labour in the field and in the laboratory has to be performed before it can be stated definitely on what lines antimalarial measures may proceed with hope of success. This last truth is particularly applicable to Kenya where there is, as yet, little or no knowledge even of the symptoms and effects of the chronic infestation with malaria parasites from which so many native children and adults suffer, to say nothing of wide gaps in knowledge regarding the distribution, relative incidence and seasonal prevalence of different species of the malaria parasite or of the rôle which different species of mosquitoes play in spreading the disease.

When one thinks on these things one's anxiety is rather lest the demand for additional staff may be on too moderate a scale than lest the recommendation as a whole may be unacceptable.

RECRUITMENT AND TRAINING OF THE SPECIAL STAFF.

There is a world-wide difficulty, at the present time, in obtaining medical men, entomologists, antimalarial engineers and other professional technicians who are expertly qualified for responsible posts in a central antimalarial service. Should an endeavour be made to recruit them from England?—or should the principle be adopted of selecting, from the roll of officers of the Kenya medical and other technical services, three or four whose general and professional capacities and attainments appear to fit them for posts of this kind, and of then arranging for them to obtain the necessary additional knowledge required in their new duties? My opinion is that the advantages of the latter plan outweigh those of the former. Men already in the Service are acquainted with the country, its peoples, their languages and customs; if they have aptitude and enthusiasm for research they will usually have found time and opportunity to practise it during their leisure hours; they have had experience of service conditions and, if any of them are found not to fulfil their promise for field and laboratory work, there is no difficulty in finding other employment for them; in this way selection of those who are most fitted for the work becomes readily operative. It is true, of course, that the additional training to be given to these selected officers will occupy perhaps a year—but it is equally true that it will take a new man about the same period to learn the language and otherwise to get sufficiently in touch with the people to enable him to work effectively among them.

What additional knowledge should the staff possess and how is it to be obtained?

It is understood, of course, that every selected medical officer will already have undertaken the courses of postgraduate study and will have passed the examinations for a “Diploma in Tropical Medicine.” But malaria is only one of many subjects treated in those courses and the period of study for the whole field of Tropical Medicine and Hygiene is very short. Moreover, in the centres where courses are unavoidably held, suitable material for an adequate study of malaria is greatly lacking and no field work can be done. Thus it happens, unavoidably, that the instruction given is quite insufficient to qualify a medical officer for appointment to a responsible post in an anti-malarial service. With obvious modifications the same is true of newly recruited entomologists from universities and other training centres in England or the Continent.

The supplementary knowledge required is concerned first with technical routine and experimental methods of observation, enquiry and research in the hospital and laboratory, secondly with practical field work and epidemiological studies in malarious countries, thirdly with what is called “Public Health Research.” Experience of practical preventive and curative work in the field which is combined

with expert enquiry to test progress and results, is immensely important; without the latter provision it is seldom useful and may be very misleading.

The English-speaking places where, I think, the requisite additional knowledge can be best obtained at present are, for the first subjects mentioned above, the malaria laboratory of the Ministry of Health in England and the malaria laboratory of the Tropical Diseases Institute at Amsterdam in Holland; for the second subjects the Central Bureau and Field Observation Stations of "The Malaria Survey of India" at Kasauli, Dehra Dun, Karnal, and other places in that country.

Two or three months should be sufficient for the necessary studies in England and Holland, but at least six months should be spent in practical field work in India. Officers who have not taken a "Diploma in Public Health" should devote an additional two or three months to a course of "Tropical Public Health Research." This can be taken preferably at the London School of Hygiene, but it may be supplemented in India at the Institute of Hygiene, which at present is part of the Calcutta School of Tropical Medicine.

I take leave to add a few general remarks on appointments to the posts of entomologist and antimalarial engineer respectively. Both are "specialist" appointments for which there is great difficulty at present in recruiting suitable officers. I think that with regard to them, as well as with regard to the medical research officers, time and disappointment might be saved by selecting junior gazetted officers locally and training them for the new duties. Kenya possesses in Mr. Symes, the present senior medical entomologist, an officer whose expert knowledge of all branches of his subject and whose practical experience of what would be required of a malarial entomologist, peculiarly fits him to train a junior officer for those duties; and, as regards an antimalarial engineer, I think it very desirable as soon as possible to make an arrangement between the Medical Department and the Public Works Department by which a junior officer of the latter Department should be seconded to work with Mr. Bennett in order that, when this expert's temporary term of service expires, there may be an officer available to continue his specialist duties. The need is the greater for those duties because no one who has had experience of them in other countries can doubt that in Kenya, as elsewhere, the work with which they are concerned will have to be maintained and extended uninterruptedly; unless this is arranged for now, there will inevitably come a time in the relatively near future when much of it will fall into decay and a great deal of the money now being spent upon it will have been wasted.

I have been led to remark at some length on these points because the results of my tour have left me with the impression that, for a reasonable time in Kenya, central Governmental arrangements should be concentrated rather on building up a permanent group of specialist workers than in hastily devised measures. Those who are

restless for immediate direct action will doubtless be disappointed with this view, but I am confident that no other antimalarial policy will give so much solid satisfaction within a few years' time.

It is too often forgotten that among the native races of Africa, malaria, like tuberculosis and syphilis, is a "social disease" and that it is not less difficult to control among such people than is either of those scourges.

DUTIES OF THE SPECIAL STAFF.

At the risk of appearing to labour my subject I shall begin this paragraph with a few remarks indicating the modern trend of thought on antimalarial policy and action.

The modern practice of attacking the malaria problem in a tropical country is different from the practice that was usually recommended even as lately as the early years of the War; as yet there is no textbook on tropical diseases in which a description of it can be found. I refer, of course, to the general problem in a country as a whole rather than to the strictly local problem of dealing with the disease in a few named towns or other small areas. Even a good many years before the War a change in thought and practice was advocated by a few practical field workers, but I have named that world event as a milestone because experience, dearly bought during its progress, was largely instrumental in bringing about acceptance of the new ideas by the medical scientific world in general.

The principal differences between ancient and modern opinion may be contrasted somewhat as follows:—

ANCIENT.

The discovery of the evolutionary cycle of the malaria parasite in mosquitoes has provided sanitarians with a master-key which will unlock all the gates that have hitherto barred the road to success in ridding the world from malaria; two simple anti-malarial methods based on the new knowledge are now available and no further research is necessary; all that is now required is to apply one or other (or both) of the two methods far and wide.

MODERN.

The discovery has not yielded the practical results that were expected from it. Each of the two methods based on the new knowledge has proved of great value in a few exceptional instances, but neither has provided a royal road or a short cut to the general control of malaria; expert knowledge and continuous investigation are essential to their successful application. Intensive research along other lines is more than ever necessary, for an antimalarial method capable of being applied by sanitarians in all malarious areas is still to seek.

As regards practice, an outstanding result has emerged from the change in opinion. So long as the old school of thought prevailed, it was held to be necessary always and in every circumstance to endeavour to deal with malaria by a method arising directly out of the knowledge of the evolutionary cycle of the parasite in anopheles mosquitoes. But since the acceptance of the new ideas, malariologists in general have freed themselves from the tyranny which that belief has exercised over men's minds during the last 30 years. They have begun to ponder the subject again and to recall to mind that there are many ways of dealing with malaria and that some of them were effective long before the malaria parasite and its vital association with a mosquito of any sort had been discovered. This wider outlook, accompanied by research and experiment, is having fruitful results. In particular it has led to the plan for dealing with malaria (and at the same time with other social scourges equally harmful) to which I shall draw attention when referring to "Malaria in Native Reserves." In general it has led to the recognition that, as yet, the medical scientific world does not possess a method of malaria control which can be described as being superior to all others and therefore to be adopted in every country. Each or any of the available methods may render valuable service in a country if it is a method well suited to the local conditions. This suitability to local conditions (meaning ability to conduct the measures freely, without opposition, so that they can be easily and quickly brought above the "minimal effective standard") is essential to the success of the method chosen.

I think that in the light of these remarks the duties of the special staff will be clear without a long explanation. Obviously their first duty will be to make themselves masters in their special technical subjects, and to maintain their mastery by continuous research and by keeping in close touch with workers in other malarious countries and with the literature of their particular branches. They are to be the "brain" which, acting through the D.D.L.S., assists the medical and administrative authorities to initiate, promote and co-ordinate antimalarial work throughout the country. Their headquarters laboratory accommodation should be in the medical Research Laboratory at Nairobi, but at least two "Field Observation Stations" should be established where they will be able to make detailed observations on malaria at regular intervals (say monthly) throughout the year for several years. These observations should be on all matters with which a complete "malaria survey" is ordinarily concerned, but in particular they should include an endeavour to record accurately the amount and character of the disease month by month and year by year, the numerical prevalence and infection-rate of anopheles in the houses at the same intervals, and the abundance of anopheles larvæ in breeding places at different seasons. At these stations also will be commenced the studies necessary to ascertain, first in general for the country as a whole; and secondly, in particular for each malarious area separately, what method of dealing with malaria is best suited to local conditions and peculiarities, and to the habits and customs of the people. On this matter there must be continuous investigation,

continuous criticism and continuous use of the imagination; and above all it is a problem that must be solved in close association with medical officers and private practitioners who have to treat cases of the disease as well as with health officers and other sanitarians who are concerned with prevention. Again, in these or other observation stations, or "sampling areas," the special staff will investigate the secondary or auxiliary factors of malarial epidemiology, to which so much attention has always to be given in antimalarial work. Some of them are concerned with the inhabitants (e.g., race, social status, habits and customs, births, marriages, deaths, maternity and child welfare, housing, work, etc.), some with the soil and environment (e.g., reclamation and clearing of land, primitive or intensive agriculture, water supply, food and general sanitation, etc.), some with anopheles mosquitoes (e.g., species, habits, abundance, length of life, etc.). It is particularly on account of the importance of studying these auxiliary factors that I have laid stress on the desirability of a course of "Public Health Research" for officers of the special staff.

Here I may mention in parentheses the "general idea" that I had in mind in preparing, with Dr. Paterson's assistance, the itinerary of my tour in Kenya (Appendix 1). Having ascertained that the medical authorities were entirely in agreement with me on the desirability of creating a special organisation for continuing and extending the work after my departure, I decided that the short period of my tour might be occupied more usefully in providing examples of the kind of observation and action which such an organisation would undertake than in making a superficial survey of the country as a whole. Thus it came about that the Deputy Director of Laboratory Services (Dr. Kauntze) in whose division the proposed organisation would naturally fall, the Senior Entomologist (Mr. Symes) and I formed ourselves into a "field working party," our avowed purpose being to work intensively and for as long as possible in two or three selected areas rather than to endeavour to cover a large part of the country. It will be seen from the itinerary that our purpose was often frustrated by unavoidable circumstances, but that in two districts, representative respectively of "settled areas" and "native reserves" we were able to establish field observation stations and to commence detailed work of the kind to which I have referred. The first has its headquarters at Kitale, the second at Taveta. I consider that it is of the greatest importance to arrange that the work begun at these stations should be continued uninterruptedly. It was at these stations that we incriminated both the common anopheles of Kenya (*costalis* and *funestus*) as carriers and transmitters of malaria, and it was here that we made the epidemiological observations upon which my recommendations for antimalarial measures on European farms in the "settled areas" are based. Here also several private practitioners availed themselves of the opportunity to visit our temporary laboratory and to obtain advice on the microscopic diagnosis and treatment of malaria. At Taveta, thanks to the assistance which we received from the District Commissioner, Mr. Jennings, who accompanied us from Voi and remained working daily with us throughout the period of our stay, we got

closely in touch with the native chiefs and inhabitants of the " Reserve," and were thus enabled to make observations on malaria and on other public health subjects which proved to be of immediate administrative usefulness.

It is not meant, of course, that the duties of the special staff will be limited entirely to investigation and research, or that measures of control should not be begun until a complete study of local problems and conditions has everywhere been made. That study is long and complicated, and much of it is of an expert nature which, from lack of a sufficient number of trained workers, can only be done in a few sample areas. What one hopes, of course, is that the particular measures to be recommended later in this Report will be conducted throughout the length and breadth of the country wherever there is a government medical officer or a private practitioner who is prepared to initiate and promote them. The special staff will have very important duties in connection with these general measures for (by correspondence and, whenever possible, by personal visits) they will always be ready to help with advice and practical demonstration and as expert referees in the identification of mosquitoes and parasites and in the scientific appreciation of work and results. From time to time they will prepare notes or memoranda giving information based on their own observations, or extracted from the literature of the subject, which will be distributed to all concerned. They will associate themselves closely with the major antimalarial projects in progress in towns and elsewhere, keeping regular records of a character which will enable the results of these measures to be appraised scientifically. They will arrange to keep in close touch with technical experts of the Agricultural, Veterinary, Public Works and Educational Departments and, in consultation with them, will prepare notes and data for schemes of " bonification," " propaganda," " settlement," and any other Governmental projects having an antimalarial purpose. They will do what they can, through official channels, to initiate and promote such schemes, and will take an active part in advising upon them from the antimalarial aspect and will arrange to make systematic malaria surveys of them at regular intervals.

Finally, it will be their duty to investigate and advise upon clinical and therapeutic problems of malaria no less than upon the preventive side of the disease. It is clear that, whatever may be said by hygienists on the merits of prevention over the merits of cure, malaria in Kenya will have to be dealt with partly by curative methods, partly by preventive ones. It was for this reason that, in our work at the field observation station which we established at Taveta, we began an experiment on the quinine treatment of native babies and young children in whose blood we had found malaria parasites and, in our work at the Kitale station, an experiment on the quinine treatment of the " native labour " and " houseboys " on European farms. I attach great importance to the desirability of making adequate arrangements for the continuation and extension of these experiments particularly because the treatment of natives who are " up and about " may need to be quite different from the treatment that suffices for patients who are in bed in hospital.

The following are my views and recommendations on each of the special problems of malaria in Kenya :—

MEASURES IN TOWNS.

The antimalarial policy which has been adopted for the towns of Kenya, and is already being put into effect in Nairobi, was described by the Medical Department in a memorandum printed, in part, on pages 19 and 20 of the official “ Report of the Select Committee on Draft Estimates, 1929.” The policy is “ to free the towns of Kenya from the menace of malaria once and for all ” by operations of drainage, filling and other methods designed to prevent the breeding of anopheles mosquitoes.

I agree wholly with this policy, and I note with satisfaction that £20,000 has been voted by Government and a similar sum by the Municipal Council for measures in Nairobi, and that an expert anti-malarial engineer (Mr. Bennett from Malaya) has been engaged for a period of two years for antimalarial drainage work in that town and in Kitale and Eldoret. I trust that all work recommended or taken in hand by him will be pushed to completion as speedily as possible, and that it will include the immediate acquisition and effective treatment of the “ Nairobi swamp,” which for many years has been largely responsible for the spread of malaria in the town. On this matter, Dr. R. Hunter, the Medical Officer of Health, in his Annual Report for 1928, has put the case in a manner which cannot fail, I think, to lead to effective action.

But, particularly as regards Nairobi, I am not at all confident that what is now being done, or is under consideration, will suffice to bring about the desired end. The magnitude of the task that is being attempted is not adequately explained by saying that “ the problem is one of drainage and filling, and of that alone ;” and to arrange only for those measures would be to court failure or an incomplete result and future criticism. I suggest that an endeavour should be made to deal with the disease itself as well as with the mosquitoes which transmit it, and that, in any case, it will be necessary to supplement major antimosquito drainage and filling operations by continuous action in the vicinity of houses within the town and suburbs, and to require private medical practitioners, householders and the inhabitants in general, to play their part in the campaign.

For this and other reasons I consider that what should be done as soon as possible in Nairobi is to appoint a “ special malarial medical officer ” who will have no other duties whatever except those connected with the prevention of malaria. He should, of course, be a trained malariologist. All antimalarial operations should be conducted under his direct supervision and control. He should be provided with a small special department of inspectors, sub-inspectors and labourers, and with an office and laboratory in the Municipal Offices alongside the department of the Medical Officer of Health with whom he will work in close co-operation. His staff should include a trained microscopist. It is essential that he should be able to devote his whole time and attention to enquiring into the source and origin of new cases of malaria in the town, to perfecting the details of antilarval

and other antimosquito measures, and to seeing personally that this work is properly conducted. Most of his time should be spent in personal enquiry (often from house to house), and in supervision and control of his staff in the field.

His task will be arduous and he should be assisted by adequate anti-mosquito legislation and regulations which must apply not only to individual householders and members of the public, but to the railways, all Government departments and all public and private bodies. No antimalarial scheme based on measures to reduce mosquitoes has ever been successful which did not include strict legislation to enforce the necessary measures.

He should also be assisted by a regulation requiring all private medical practitioners in the town to notify cases of malaria among Europeans and Asiatics occurring in their practice by name, age, and place of residence, the notification to be accompanied by a blood film, which should be examined and reported on free of charge. To facilitate the working of this regulation microscope slides, accompanied by a simple printed form (with headings, patient's name, sex, age, address, first attack or relapse), should be distributed to all practitioners, and it should be arranged that (if this is desired) an inspector will be sent each day to the houses of the doctors to collect the notifications and slides, and to take them to the laboratory. The slides should be examined at once, the result being recorded on the back of the form, which should be returned to the doctor after the particulars of the notification have been recorded. When a new case of malaria has been discovered in this way it should be arranged with the practitioner that the house will be visited and searched for mosquitoes, which should be taken to the laboratory for identification and dissection. Their breeding places should be ascertained and dealt with, and the practitioner should be requested to inform the householder of the action against mosquitoes which he should take in future. It is very desirable to enlist the active co-operation of private practitioners in this way for, nowadays, in every civilised country, all private practitioners should be ready and willing to collaborate by working for the health of the community as well as of the individual, and their assistance is of the greatest service. If it is considered that some inducement to notify cases is desirable, a fee for each notification may be paid, but I think that, as the blood film will be examined gratuitously, the fee should not be more than 2s. At present, for the examination of a blood film sent by a practitioner to the Government Laboratory a fee of 10s. is charged; this will no longer be the rule if the system recommended here is adopted.

I am the more desirous that major schemes of drainage, filling, etc., should be supplemented by action of the kind just outlined, because I am convinced that in the towns of Kenya generally, malaria is essentially a household or family disease which, when those works are completed, can be dealt with most successfully by householders themselves acting on approved medical advice. In Nairobi and other towns native domestic servants are housed on the premises of their employers; they are usually the original source from which anopheles mosquitoes become infected with malaria.

The Special Malaria Medical Officer and his staff should, of course, be appointed by the Municipal Council of Nairobi and their salaries and the cost of the Department should be met entirely from municipal funds; the Municipal Council should be solely responsible for the public health so far as malaria is concerned. Single control is essential to the success of any antimalarial scheme. The Special Malaria Officer of the municipality should be the advisory, and, as far as may be practicable, the executive officer for all purposes of malaria control.

I suggest that the officer selected for the post of Special Malaria Officer, Nairobi, should, before taking up his duties, attend one of the malaria courses held annually in October under the Director of "The Malaria Survey of India" and that in addition he should be required to study the preventive measures now in operation in the city of Bombay, as recently recommended in the official report by Major G. Covell, I.M.S. Three months should be a sufficient period of absence for these purposes; I am confident that the experience gained would fully justify the necessary expenditure.

Except to approve wholly the antimalarial drainage and filling schemes which Mr. Bennett has in hand, I have intentionally refrained from making recommendations involving heavy expenditure because I think that, if the municipal corporation, as the representative of the public, accepts the whole responsibility of antimalarial action; if they are successful in obtaining the services of the right type of trained malariologist as their own special malaria officer; and if they give him adequate moral and material support, he will succeed in freeing Nairobi from the menace of malaria at no great expense. He will do so because: (1) he will be thoroughly equipped for the task and will quickly get to know all about the disease in the town from every aspect; it is a truism that for effective action in the prevention and cure of malaria, knowledge is power, (2) as a municipal officer, working exclusively for the benefit of the residents in general, he will secure the interest, co-operation and active assistance of all concerned, (3) he will personally supervise and control the progress and results of major drainage and other antimalarial works in the general environment, but in addition (with the co-operation mentioned) he will make adequate arrangements for discovering and dealing promptly with new cases of malaria as they occur, and with the factors concerned in their source and origin; thus he will prevent the disease from spreading in epidemic form to other houses and families as it did, for example, in 1926. In stating this opinion of what might be accomplished by the special malaria officer I do not desire at all to minimise the difficulties with which he will be confronted in his task. I am aware that Nairobi is as yet hardly 30 years old, that its site was badly chosen and its original layout badly planned, that its sanitation has been, and continues to be, a problem of grave concern and that its population includes some 18,000 natives and nearly 10,000 Asiatics, many of whom live in

slum areas under conditions which have been described officially by the Medical Officer of Health as "appalling." No one who reads what is said on these and other sanitary matters in the "Report of the Local Government Commission 1927" can fail to realise how great the difficulties may be. Moreover, up to the present time, Nairobi possesses no legislation nor machinery for the collection of vital statistics, no system for the registration of births and deaths, and no regulations requiring practitioners to give a certificate of the cause of death. Permits to bury those who die are issued by the police and in many of the reports of death sent to the Medical Officer of Health by the police the address is so incomplete that the place of death cannot be found. If no practitioner was in attendance on the deceased, the police apply to the Medical Officer of Health who has to issue a certificate on hearsay lay information. Although a lady medical officer is employed for child welfare work, no one knows what the infant mortality rate of the town may be, for no one knows the annual number of births. Private practitioners are paid a fee of 4s. when they notify a case of acute infectious disease, but, from the scanty information which they furnish, it is often impossible to find the patient's dwelling. Even the records of rainfall and other meteorological data as printed in the official "Handbook of Kenya Colony and Protectorate" are said to be so inaccurate that I was advised by Mr. Walter (Statistician to the Governors' Conference) not to use them in this report.

MEASURES ON THE RAILWAYS AND ROADS.

The Kenya and Uganda Railways and Harbours employ permanently about 530 Europeans, 2,650 Asiatics and 15,700 Africans, and in addition a large staff (permanent or temporary) for railway construction of all kinds. Because the railway is the largest employer of native labour in the country and because a large proportion of this labour must be housed near its work in important townships, the railway has a great responsibility in relation to malaria, for native labour is known to be the chief source and origin of the disease. The railway population of Africans at Nairobi is 2,877, at Kisumu 2,453, at Kilindini nearly 2,000, at Voi 1,200 and at Mankindu 870. Many of these people and their wives and children, being carriers of malaria parasites, are a constant reservoir of malarial infection to the local anopheles which thus become able to spread the disease to Asiatics and Europeans. The Public Works Department, as makers of roads, bridges, buildings and bricks, has a similar problem and responsibility. Moreover, digging holes to get earth is a necessary evil in railway and road construction, and the embankments for which the earth is used, by damming the natural drainage channels of the country, often create conditions favourable to an unnatural prevalence of malarial mosquitoes. Thus it is not surprising that in Kenya and Uganda, as in every other developing tropical country, one should hear a great deal of the bad

effects associated with the making and maintenance of railways and roads, and of the neglect of the responsible authorities to prevent or remedy those effects.

Fortunately, so far as Kenya is concerned, the necessary first step to proper antimalarial action on the railways has already been taken. In October, 1928, Dr. K. Wallington was appointed Medical Officer of the Kenya and Uganda Railways and Harbours, and the arrangements which he has already made, or will shortly be made as a result of his recommendations, will go far to remove the railway's present bad reputation as a source and agent of spread of malaria. He was good enough on several occasions to conduct me on inspections of railway staff and premises up and down the line, and he has supplied me with an account of his suggestions and recommendations for each station and railway reserve as far as the Uganda border. Unfortunately, if I am not mistaken, although he is Medical Officer of the railway as a whole, it has not yet been made clear whether or not his activities extend to the section of the line which runs through Uganda; and when I inspected the railway staff and lands at Tororo (the first large station in Uganda and rightly regarded as a "hotbed of malaria and blackwater fever") I was conducted by Dr. Caldwell, District Surgeon, Uganda Medical Service, who, in general, has more than he can do to cope with the town and district hospital and out-patient work. This station (Tororo) was described to me by many inhabitants of Kenya as being the place where they contracted their first attack of malaria. For this reason, on returning from my second visit to Uganda, I stayed a night at the hotel there and visited the quarters of a number of Indian members of the railway staff and interviewed them and their families. At this time 34 Asiatic officials out of a total of 77 were (or had recently been) "off-duty" on account of malaria and among the European population of the town 3 cases of blackwater fever were under treatment. Dr. Chell, Acting Director, Medical Service, Uganda, accompanied me and we received much assistance from the District Commissioner, whose house included a small room off the back verandah (unscreened) in which were more *Anopheles* mosquitoes (*costalis*) than I had ever seen previously in a house in East Africa. We sprayed them with "Flit" and filled a test-tube with their dead. We also caught numbers under the eaves and on the inside of the "mosquito-proof screening" of the hotel verandah. Some particulars of the prevalence of malaria parasites and clinical attacks among railwaymen and their families at Tororo and some details of the condition in which we found their houses will be recorded in technical articles to be published later; here I wish only to make the following recommendations:

- (1) The Medical Officer, Kenya and Uganda Railways and Harbours, should have sole control and responsibility, under the General Manager, for antimalarial measures (whether they are of a preventive or curative nature) throughout the railways and harbours of the two territories in which the railways run. The present practice by which

his activities seem to cease at the Kenya border should be changed and he should be as much concerned to take proper steps to deal with malarious conditions in railwaymen's houses and on railway reserves in Uganda as he has hitherto been in Kenya. As a first step Tororo should be classed as an "unhealthy station" and measures should be taken to improve and repair railway houses which at present have no ceiling, no mosquito-proofing and no separate drainage.

(2) The railway authorities should consider whether they could, at an unhealthy station like Tororo, build and run a hotel similar to the existing railway hotel at Masindi. Possibly the venture might not be a "paying proposition" commercially, but that is of little importance when the present risks run by travellers are considered. The hotel should, of course, be effectively screened against mosquitoes in such a way that visitors can use the verandahs, public rooms and bedrooms without fear of contracting malaria, and it should be supervised from the health point of view by the railway medical officer with the same care as should be exercised with regard to station buildings. In my opinion it is wrong, at an important railway station where malaria is rife, to leave to private enterprise the provision of accommodation for European settlers and their wives and children who are on their way from up-country to the coast and (in the absence of a daily train service) must stay a night on the way.

(3) At stations where it would not be justifiable for the railway to build and run a hotel, but where travellers must often spend some hours of the evening or night (as at Voi) the accommodation of the waiting and rest rooms should be carefully examined from the antimalarial point of view, and steps taken to make these rooms safe. I succeeded more than once in finding anopheles mosquitoes in station rooms or offices, and one of the earliest experiences of my tour was the finding by Mr. Symes of a specimen of *A. funestus* in the bedroom of a hotel in which mosquito nets were not provided.

(4) I have studied the recommendations made from time to time by Dr. Wallington in special reports to the Acting General Manager, Kenya and Uganda Railways and Harbours, of which copies were forwarded to me by Dr. Wallington in April this year. I agree with all of them and trust that they have already received attention. The following is an example of one of these reports:

"Turbo. The condition of this station is poor. At the time of my inspection rain had been falling daily for some time and water was standing all over the ground. Drainage of the station reserve is difficult and would be costly. Long grass was growing round all buildings and the whole station presented an air of neglect. The buildings are widely scattered and there appears to have been no attempt to plan their outlay. Except one block, which is built in concrete, the type of landies is most unsatisfactory. They are built of brick and, as the verandahs

are not concreted, most of them resembled a sea of mud. The rooms have inside fireplaces and were in a dirty state. The drains leading from the stand-pipes were choked. Long grass surrounded the station-master's house and rubbish littered the space behind. The house was not screened. In the European closet the bucket was leaky, and fluid from it was trickling over the floor. The arrangements for sweeping appeared to be unsatisfactory.

There is a large swamp below the site of the station between it and the river.

I recommend that attention be directed in the first place to a general "clean-up" of the station reserve which should include grass cutting over a wide area and particularly in the vicinity of dwellings. Drainage for all quarters should be provided. The station-master's house and the signaller's should be screened. Later a scheme of drainage for the whole area should be considered."

MEASURES ON FARMS.

The prevention of malaria on farms in the rural settled areas is essentially a matter of household and personal measures carried out by the settler himself on approved medical advice. As conditions are not the same in all areas, few rules applicable generally can be laid down. It will be the duty of "The Malaria Survey of Kenya" to continue the observations which were begun (with Kitale as headquarters) during my visit and gradually to work out, for each malarious farm separately, the plan which is most suitable to the local circumstances, having regard to the financial situation of the settler no less than to the purely scientific aspect of the subject. What is said about measures in the rural settled areas on pages 20 and 21 of the "Report of the Select Committee on Draft Estimates 1929" is correct so far as it goes; what is needed now is a considerable forward movement in arrangements already in being. A definite programme for each farm, accompanied by sketch plans, should be lodged in the central bureau of the special malaria organisation and there should be a system of periodical inspection by one of the members of that staff to see that the programme is being followed and to ascertain how it might be improved and made more effective. I am aware that one Medical Officer (Dr. Anderson) is already employed in making personal visits to farms to give the kind of advice and assistance that is recommended here, but it is obvious that, as there are more than 600 occupied farms in the Uasin Gishu and Transnzoia districts alone, one Medical Officer is not sufficient for this work.

The following are some points to which attention should be given :—

(1) *Site of the settler's house.*—This is probably more important than anything else. When a farmer first settles on his undeveloped land he pitches his tent or puts up his "banda" near an existing

stream. For getting water this is convenient, but nothing is more likely to result in illness and disaster. The bank of the stream soon becomes trampled by oxen and native boys, pools are formed, long grass and water-weeds flourish, and a small swamp is created which becomes a prolific breeding place of anopheles mosquitoes. It always happens that some of the native boys have malaria parasites in their blood; they are bitten by the swamp mosquitoes which soon become infective and in turn bite the settler who, not being immune, begins to suffer severely from malaria; he cannot get on with his ploughing, sowing and fencing, and his hopes of gaining any kind of return from his land are indefinitely postponed.

There are still in Kenya (particularly in the Nakuru district) too many examples of badly sited homesteads on lands where a healthy site could easily be found; in these cases it would be far better (and probably in the end less expensive) to demolish and rebuild than to endeavour to protect the existing houses from mosquitoes.

(2) *Environment of the settler's house.*—What I wished to say on this subject has already been said so well by Leonard Flemming in "The call of the Veldt" that I think I cannot do better than recommend settlers in Kenya to read that book. There are, in addition, three practical points to which I would direct attention. The first is that no huts, even for houseboys, should be permitted within two hundred yards of the settler's house. I think this is the shortest distance from the house at which even houseboys with their wives and children should be permitted to live. Permanent native farm labour should, of course, be housed at least twice that distance away and "squatters" should not be permitted to build huts nearer than at least half a mile. The second is that the immediate surroundings of the house should not be disfigured by "offices," grain-sheds, store-houses, posho-grinding sheds, tractors and other farming machines and appliances. It may be very convenient to be able to supervise the distribution of "posho" from the back verandah of the house, but, on a well-run farm, the homestead should be the haven to which the settler goes for rest from all those and other farming activities. The third is the problem of the stream or streams running in the valley below the house. It is to be hoped, of course, that water for the house will be obtained by means of a well and aeromotor pump on the house site, and that the house will be half a mile or more from the stream; but the stream will still be an important problem, because the farm labour and "squatters" will get their water from it, oxen and other stock will be watered there, and probably it will be the site of the settler's vegetable garden. It must be regularised and "trained" and the banks kept smooth and free from long grass. Whatever happens, it must not be allowed to form a swamp. If it is dammed at any part to make a pond for irrigating the vegetable garden or for other purposes, great care must be taken to prevent making artificial breeding places for anopheles mosquitoes. The sides of the pond

must be steep and smoothly plastered. Ducks kept on the pond scour the edges very successfully and pick up many mosquito larvae, and they will often wander up and down the stream doing the same good work. If, in spite of regularising the stream bed and keeping the edges of the stream and pond clean and free from weeds, anopheles larvae are plentifully found, it may be necessary to use Paris Green or oil. These points will be explained by the medical officer who visits the farm when he enquires into the sources of anopheles and malaria. Squatters should not be allowed to build their huts near the stream; if not prevented, they will always do so on account of the water-carrying problem.

(3) *Type of house*.—Next to the site and surroundings, the type of house is most important. Personally if I were to build a home-stead on “the Plateau” in Kenya or in any other place which is liable to invasion by mosquitoes, winged ants, flies and other harmful or disagreeable flying insects, I would build a type of house with a wide verandah all round it so that it could be effectively screened against their entry; but possibly this is because, having passed so much of my life in malarious countries and among malarious people, I have a wholesome fear of that disease. I learnt during my tour that although in Uganda, and in parts of Rhodesia, everyone has a screened house if he can afford it, hardly anyone in Kenya seems prepared to adopt this protective measure. I learnt also that many residents in the Uplands of Kenya are similarly unwilling to adopt other measures of personal protection; they would be glad to be rid of malaria if Government, or an “expert,” would rid them of it, but it is a different matter if they must take action themselves. Indeed, on several occasions, I met old-established residents who told me that it was not necessary for them to take personal precautions because they were already “immune to malaria,” and I met new arrivals who were suffering from the disease because (as it seemed to me) they thought that a few attacks of malaria aided a pioneer “to acquire merit” particularly if the attacks ended in their getting “blackwater.” Several people told me, with obvious pride, that they had had two or more attacks of the latter disease. A farmer who had been on the same farm in the Kitale district since 1913 told me that between 1915 and 1925 he had had four attacks of blackwater fever, and that his wife had had this disease once in 1920, twice in 1923 and twice in 1928. They were still living in the house (of wattle and daub with a thatched roof) which he had built when he first bought the farm.

Even some settlers who have been successful and are now “well-to-do” still have houses with a thatched roof and no ceiling, making the excuse that this type of house is picturesque to look at and cool and airy to live in. It is the type implied in the government pamphlet “Summary of closer settlement proposals 1928” in the words: “It is not recommended that a complete dwelling-house be erected in advance on each holding; some simple form of shed

should be provided for immediate housing purposes." From the point of view of malaria prevention, outstanding disadvantages of this kind of housing (which is apparently copied from native practice) are that the thatch affords favourable shelter to infective mosquitoes as well as to rats, bats, snakes and other vermin, that the absence of a ceiling prevents mosquitoes being seen and killed, that the irregularity of the eaves makes it impossible to screen the verandahs effectively and that it is difficult and expensive to keep the thatch in repair.

However simple or inexpensive the type of house may be, it should be constructed on the principle of affording as little shelter as possible to mosquitoes; it should be orientated and designed so that wind and air-currents pass freely through it; it should be free from damp at all seasons; ceilings should be provided for all rooms; the walls and ceilings should be whitewashed or colour-washed a light colour; there should be no dark corners or recesses where mosquitoes can hide, and there should be no superfluous furniture, curtains, hangings or pictures. Clothes should be kept in properly made cupboards or wardrobes instead of being hung from nails round the walls and behind the doors of the bedrooms, and every bed should be provided with an untorn rectangular mosquito net hung inside the framework of rods and bound with a strip of calico where a sleeper's feet or arms might press against the netting. It is regrettable that, even in some so-called first class hotels in Kenya, mosquito-nets are not provided, and that in others the nets supplied are of the old-fashioned "army bell-net type" which are stuffy and afford quite inadequate protection because in them a sleeper cannot prevent his feet or arms from lying against the netting so that he gets bitten as much as if he used no net. It is unfortunate, too, that during my tour it should have been possible for me to be informed of instances where guests staying at farms for a single night contracted malaria, apparently because their hosts, being themselves indifferent to the bites of mosquitoes by reason of their "immunity to malaria," had made no provision to protect their less fortunate friends and relatives.

(4) *Position of the kitchen.*—In Kenya, as in India, it is usual to build the kitchen separate from the house and to place it a good many yards away. Sometimes it is connected with the house by a covered path. I think that in a climate like Kenya it is as unnecessary that the kitchen should be detached and at some distance from the house as it would be to have a detached kitchen built at the end of the garden of a dwelling in England. The kitchen is certainly a most important room; it should be within the house itself. The housewife (or the settler himself if he is unmarried) should be able to go into it and to supervise what is being done there just as often as would be done in England. There is all the more reason for this constant supervision in Kenya because one has to employ an ignorant native cook who must be taught every detail of cleanly housewifery. He has to be taught to be clean in person and

practice; that all drinking water must be boiled and filtered and all milk sterilised; that no tainted fish or meat is used; that all uncooked or cold food must be stored where it will be cool and well protected from flies; and that the art of "washing-up" must be done in a proper manner. A hundred and one things must be supervised in a well-run kitchen, for nothing affects so greatly the health, comfort and happiness of all who live in the house. This supervision cannot be exercised in a kitchen which is separate from the house itself; a detached kitchen soon becomes a place which neither the settler nor his wife can enter except at the routine morning inspection. The cook's wife and children come to regard it as part of their own quarters, and their friends, as well as fowls, ducks, flies and sometimes even a pig or a goat, use it as a common meeting place. If it is said that the smell of cooking and the heat from a kitchen within the house would be disagreeable, the answer is that several homesteads in Kenya already have indoor kitchens, some of which compare favourably with kitchens in houses in England. In Kenya native labour is cheap and very amenable to instruction; there is every opportunity for practising household management scientifically as it should be practised.

(5) *Quarters for native houseboys.*—Again as in India the common practice in Kenya is to provide two or three huts for houseboys within a few yards of the back of the house. We were able to demonstrate to settlers on several occasions that this is a dangerous practice, because it usually happens that some of these boys and their wives and children are carriers of malaria parasites and capable of infecting the anopheles mosquitoes which spend a night in their huts and may fly next day into the settler's house. On one farm we found that four of the five houseboys had malaria parasites in their blood and we found five infective anopheles among 38 that were caught in their huts. The reason given for placing the quarters for houseboys so near the house itself is that it is desirable always to have the servants within call. This is again a problem in household management easily solved by a better plan than that of making the servants live in huts in the compound of the settler's own house.

MEASURES FOR NEW SETTLERS.

Intimately allied to the problem of preventing malaria among Europeans on established farms is the problem of its prevention among newly arrived settlers who take up undeveloped land and must live on it for several years before it yields a financial return. During my tour I studied on several occasions the circumstances in which settlers in this category live, and the conditions which favour malaria and blackwater among them. I discussed this subject on several occasions with the Director of Medical and Sanitary Services. He drew my attention to a government document entitled "Summary of Closer Settlement Proposals 1928" and asked my opinion of the antimalarial measures which should be taken to safeguard new-comers

of the types referred to in the document. I reported to him as follows :

(1) the areas which it is proposed to allocate for the purpose of closer settlement should be examined to ascertain their conditions and circumstances with regard to malaria, and re-examined from time to time during occupation ;

(2) if an area is already, or is likely to become, malarious, intending settlers on it should be so informed and, prior to arrival, should be instructed as to the household and personal precautions which they should take to protect themselves from the disease ;

(3) if they must live for some time in tents and for a longer time in a thatched hut (as most new settlers in Kenya have to do) it should be insisted that they agree to use a proper mosquito net and mosquito boots and that they will be prepared to take such other personal precautions as may be advised locally (as for example, to treat any "houseboys" who live in their immediate vicinity regularly with quinine) ;

(4) When a permanent house is built attention should be given to the points noted on pages 22 to 26 and it should be properly screened against mosquitoes with wire mosquito screen-cloth 14 mesh* ;

(5) until a properly screened house is available a new settler should not be accompanied by wife or children. Also he should be of a type cultured enough to understand and to utilise for his own protection preventive measures against malaria, sunstroke, typhoid fever, relapsing fever, dysentery, worms and other tropical diseases and conditions. He should be inoculated with T.A.B. vaccine before arrival.

I may add, relative to the period of local training before taking up an allotment, that it is very important that farms selected for receiving pupils should be in healthy districts, that the farmer should be married, and that the pupil should be boarded with the family until he has learnt the language, the manner in which houseboys and farm labour should be trained and supervised, and the various measures of personal and household hygiene that he must take in order to keep healthy when he begins life on his own lands. I was informed of several instances in which ignorance or lack of care in selecting farms for pupils had resulted in the pupil suffering severely from malaria within a short time of his arrival and of one instance in which a pupil, after spending two years on a low-lying farm in a malarious district, developed blackwater fever.

MEASURES FOR NATIVE LABOUR.

I have already mentioned that in Kenya native labour is the chief source and origin of malaria, and that it is equally as important to

* The correct specification of mosquito wire gauze ("screencloth") for excluding mosquitoes from buildings is "14 mesh screencloth of 30 I.S.W.G. (Imperial Standard Wire Gauze).

endeavour to lessen the extent to which anopheles mosquitoes are at present being infected from these people as it is to endeavour to reduce the prevalence of those mosquitoes in particular areas or in the country as a whole. It would not suffice to limit effort to one or other of these plans; we must ascertain in every important area all the factors concerned in the spread of the disease, and we must deal with each of these factors as best we can. Natives are employed (1) as "houseboys" and in various other domestic capacities; (2) in public and private works and services of water-supply, conservancy, railways, roads, farming, police and many other activities. We ought to take up separately each particular activity and consider what should be done to improve the health of the labour employed in it and what should be done to prevent this labour being a menace to the health of the general community. Here I can indicate only a few principles and suggestions. First I must mention again the problem of "houseboys." I have said that on farms the living quarters for houseboys should not be in the immediate vicinity of the homestead; they should be at least 200 yards away from the house. This recommendation is not unpractical, nor even unusual, and it has no political significance; it is simply a common-sense method of lessening the risk that anopheles mosquitoes infected in the native huts may get into the settler's house. Moreover, when this plan is adopted it becomes less necessary on medical grounds to build model dwellings for houseboys and their families. On a farm in Kenya I was shown a building, comprising four single rooms for houseboys and four small storerooms, which had cost £350. Not many settlers can afford to put up such expensive quarters for their houseboys and permanent labour; and it has already been mentioned that the problem of malaria on farms must be solved with due regard to the financial position of the settler as well as to the strictly scientific aspect of the subject. A plan which should receive attention relative to this matter is the curative treatment of houseboys and permanent labour who are found to have malaria parasites in their blood. From the experiments made by Dr. Anderson at my request during my tour, it would appear that this practice can be conducted without undue difficulty, and that a dose of 15 grains of quinine given once a week may be sufficiently effective. If the further trials which Dr. Anderson is conducting under the direction of Dr. Kauntze continue to show satisfactory results, settlers will have in their hands a practicable method of reducing the sickness-rate among houseboys, permanent labour and squatters, and of lessening the influence of an important factor in the spread of malaria. This is a plan which should also be of service in Nairobi and other towns where, from lack of space, houseboys are unavoidably housed on the premises of their employers.

It is a more difficult problem to deal with malaria among the labour of the Public Works Department, the railways and other public activities, partly because some of these works (for example brickmaking) are of a kind which create facilities for mosquito breeding and the epidemic spread of the disease. In particular cases special enquiry by the Malaria Survey Organisation into all the circumstances connected with the labour employed is very desirable.

Housing is one of the most important matters to which attention should be given, as is shown, for example, in an official report by Dr. Procter, Medical Officer of Health, Kisumu, on the housing of Government native staff in that place. I have already noted the satisfactory practical step taken by the authorities in appointing a specialist railway medical officer; it would be equally valuable if the Public Works Department would do the same for the benefit of the very large labour staff which they employ.

MEASURES FOR ASIATICS.

In Kenya there are nearly three times as many Indians as there are Europeans. Most of them live in the larger towns, but there is probably no village in the country without its small Indian shop and about 2,600 Indians are employed by the Railway and many by the Public Works Department. Knowing that in their homes in India most of them must have passed through many attacks of malaria in early childhood, I was surprised to learn how severely they suffer from the disease in East Africa. It exemplifies the observation that immunity to malaria acquired in one country does not necessarily afford protection against what seem to be the same parasites in another. The incidence and fatality of blackwater fever among them is surprisingly high; I met an Indian sub-assistant surgeon who had treated more than 50 cases during a comparatively short period of service in Uganda. Obviously this is a field of investigation which might yield fruitful results, but, indeed, the whole question of "malaria and blackwater fever among Indians in East Africa" should be the subject of an authoritative special enquiry, preferably with the assistance of an officer of the Indian Medical Service who can speak Hindustani and knows Indian habits and customs. In the short time at my disposal I could do no more than ascertain the prevalence of the disease among children in one or two Indian schools and railway quarters, and among adults in the employ of the Public Works Department and Railway. I also made what enquiries I could from Indian assistant surgeons and sub-assistant surgeons employed in hospitals, and visited the Indian bazaar in various townships with them. I was able to see for myself some of the overcrowded and insanitary conditions and circumstances of Indian life which were described so forcefully by Professor W. J. Simpson in a special report written in 1913, and I cannot but regret that these intelligent, industrious and thrifty immigrants should be permitted to reproduce in the towns of Kenya the squalor that characterises the worst parts of Bombay and Calcutta in their poorest quarters. So long as immigrants who are acutely susceptible to malaria are allowed to live under those conditions in the principal towns, it is improbable that any amount of "filling and drainage" of surrounding areas will free them from the menace of epidemics of the disease.

MEASURES IN NATIVE RESERVES.

Except as regards the provision of a special organisation to be called "The Malaria Survey of Kenya," all the views and recommendations recorded up to this paragraph of my report are concerned with plans for dealing with malaria among particular groups of

people who live in places or under conditions where accepted standards of living, and the medical and sanitary arrangements, make it necessary and practicable to utilise more or less direct methods of controlling the disease. Perhaps at present some 100,000 inhabitants of Kenya might be affected by these measures. Now I have to consider what is to be done about malaria among the $2\frac{1}{2}$ million people who are the bulk of the population. They are distributed over 200,000 square miles of country. In general they are naked, poor, illiterate, uncultured and almost entirely without common things like soap, beds, tables and chairs, which are usually believed to be necessary, or at any rate desirable, for a comfortable life. Their huts are little better than those of primitive man, and so many of them are chronically under-nourished and infected with worms and other parasites and pathogenic bacteria that it has often been said that the inhabitants of some districts do not know what "health" means. We found that in general the index of malarial endemicity in the native reserves varies between 30 and 80 per cent. and that those natives from the reserves who seek work on farms, on roads, on railways or in towns carry the infection with them and are the source from which malaria is spread to Asiatics, Europeans and other non-immune immigrants. Therefore if we are to attack malaria at its origin in Kenya we must take measures to deal with it in the native reserves. How is this to be done?

I think it is important to agree in the first place that malaria in the native reserves cannot be dealt with as an isolated problem. If we possessed a specific preventive method for malaria comparable to vaccination for smallpox, we should, of course, concentrate all our resources on applying it, but as yet no royal road nor short cut of that kind is available. And, although it is obvious from what has already been said and recommended in this Report that present knowledge enables and requires us to deal with the disease and its insect carrier by direct measures in particular circumstances, it must be equally obvious that these unavoidably expensive and difficult measures cannot be applied to the two million and more people who are the indigenous peasantry of the country. Among them malaria cannot be dealt with satisfactorily as a matter separate from other medical and public health problems, nor without the aid of an educational campaign organised with a view to getting the people to understand and to take advantage of medical and sanitary arrangements established for their benefit. Almost certainly, too, the present low economic status of the people must be raised before this educational campaign would be appreciated and its teachings put into practice. Therefore, this economic improvement is the matter to which attention should first be given. It is well known that natives in general are not very willing to bestir themselves greatly about their health or to adopt modern sanitary practices, and that the best way to gain their interest and co-operation in those matters is to link them to a scheme whereby the material possessions as well as the health and well-being of the participants will be increased. In this respect mankind in general is very much the same all the world over.* On the last two days of

* See also page 24.

my tour in Kenya I saw the educational public health campaign, based on ankylostomiasis, and other worm infections, which was organised and is being conducted by Dr. Phillip and Dr. McLennan in a native reserve of the Digo district, near Mombasa. The inhabitants of this coastal area seemed to me to be less poor and primitive than people in the interior of the country. It was evident that they appreciated the excellent results of curative treatment for worms, and, in return for this benefit, some of them had constructed satisfactory cesspit latrines and improved their housing conditions. Nevertheless, it appeared from questions asked and speeches made at a meeting which I attended with Dr. Phillip, that those present were more concerned about material prosperity than about health. The attitude seemed to be that if Drs. Phillip and McLennan (who have won their entire confidence and admiration) could provide them with a plan for increasing their worldly wealth, they would be happy to humour them by spending some of it in adding windows to their houses, building latrines, white-washing and other sanitary improvements in accordance with their teachings. Unfortunately, Dr. Phillip was not in a position to promise them that a hospital would soon be built in their reserve, or to provide them with a remedy for a disease from which they said their cattle were dying. I felt that he had an uphill task and that it may be unreasonable to ask natives, who have only the bare necessities of life, to build better houses and to make other sanitary arrangements when one cannot at the same time assist them to obtain more money than they have at present. I did not think the contention that, if they would take the initiative by doing what was advised about their health, they would become stronger and able to work harder and to earn more money, struck them as an attractive appeal. Evidently they thought that if, in the first place, they could be shown how to improve their financial position, an improvement in their health would follow naturally, or as a result of the measures which they would then have the means to carry out. This is the line of reasoning which justifies the modern view that the correct way of beginning to combat malaria and other "social diseases" in poverty-stricken countries is to introduce agricultural schemes which aim primarily at improving the economic prosperity of the people, but are accompanied by progressive arrangements for adequate medical attention in sickness, for technical and elementary school education, and for simple sanitary measures of housing, water supply, conservancy and general welfare. I think this is what should be done in Kenya. It seemed to me during my tour, that although a great deal of thought and attention had been devoted to schemes for European settlement in Kenya, no concrete plan or Government project was available for assisting the natives of any part of the country to develop their lands scientifically or to improve their economic status and standard of living. Except the Kano Plain (about which some tentative suggestions for an agricultural irrigation project may have been made by the Medical Department) I was shown no locality where a scheme with that end in view seemed to have been contemplated. The advantages of these schemes (which in Holland, Italy, Egypt, Palestine, India and other countries, are called "bonifications") are that, while being very profitable to the Government concerned, they are of immense benefit to the indigenous population by changing

completely their material conditions so that instead of being poor, sparse, semi-nomadic and uncivilised, they become settled and well-to-do, and able and willing to assist actively in combating malaria, tuberculosis, syphilis and other "social diseases." The sources of malaria are not eradicated by these schemes, but as the people live in better houses, have more and better food, and are within easy reach of medical aid, they are not infected so frequently, and the disease, when it occurs, is quickly and effectively treated and overcome. Severe and fatal cases become rare, and, after a time, the disease ceases to be of great importance as a cause of sickness and death. I think that there is great scope for schemes of this kind in the native reserves of Kenya and that as soon as possible a special committee comprising members of the Agricultural, Engineering (Public Works), Medical, Veterinary, Educational and Administrative Departments should be convened to draw up a definite agricultural settlement scheme for natives in one of them. It should, of course, include a system of irrigation by which a large area of land will be made to yield a profitable return. Lack of water is the fundamental agricultural, and even domestic, difficulty in native reserves in Kenya; and it is strange that even the "proposals for closer European settlement, 1928," are silent on the all-important question to the agriculturalist of the quantity of water which will be at his command and of the amount it will cost him. According to the experience of the Union of South Africa the importance of the water rights of agriculturalists cannot be exaggerated. Egypt, the Sudan and India could be asked to lend plans and estimates of bonification schemes based on irrigation which have proved successful in those countries, or perhaps it might be feasible to depute a small committee to one of them (preferably the Sudan) to enquire into the matter.

The duties of the Special Malaria Survey Organisation in relation to these schemes have already been referred to on page 15 (lines 27 to 35).

In making this recommendation I am aware that, early in the present year, a Motion was passed in the Legislative Council recommending the Government to appoint a Commission to report on the progress of agriculture (including native agriculture) in the Colony and "to make recommendations for its improvement and as to the best methods by which Government's support of the industry can be given"; also that in 1926 the Department of Agriculture reviewed the position of native agriculture in Kenya and made various suggestions for improving it particularly by (a) the use of better implements, (b) the control of agricultural pests and diseases where feasible, (c) the issue of better seed, (d) better arrangements for buying native produce, (e) the demonstration of better methods of agriculture, and (f) training natives (especially children, youths and women) in elementary agriculture.

UGANDA.

MEASURES IN KAMPALA.

I visited Kampala from the 22nd to the 30th April and again during the first week of June. The recommendations which I made on the termination of my first visit were stated in a memorandum to the Honourable the Chief Secretary to Government as follows:

KAMPALA, UGANDA.

1st May, 1929.

TO THE HON. THE CHIEF SECRETARY,

ENTEBBE.

At the interview which you kindly gave me this morning you asked me to send you a note of the preliminary action which I consider should now be taken relative to antimalaria measures in Kampala.

2. You will probably wish to be informed in the first place of the chief results of the inquiry into the amount of malaria and the incidence of the malaria carrying mosquitoes in the township which I have been able to make during my present visit from the 22nd to the 30th April. Facilities for this inquiry were kindly arranged by Dr. Chell, and I am particularly indebted to the Agricultural Department for permitting Mr. Hancock to collaborate with me in the work.

3. Our inquiry into the amount of malaria in Kampala at the time of my visit was limited to an examination of African and Indian children and adults chosen at random among the inhabitants of different areas in the town. The proportion of native children whose blood was found to contain malaria parasites at the time of examination varied in different areas between 33 to 60 per cent. Nearly 50 per cent. of the Askaris' children under 5 years of age in the police lines had malaria parasites in their blood and 60 per cent. had enlarged spleens. To obtain an indication of the amount of malaria among Indians we examined 50 boys and girls attending the Indian school in the bazaar and 32 adult artisans (chiefly Sikhs) of the Public Works Department. Among these Indian school children, the proportion with enlarged spleens due to malaria was 20 per cent. and among the 32 artisans we found 6 who were suffering from marked splenic enlargement and two had malarial parasites in their blood. Of those 32 persons 14 gave a history of recent attacks of malaria and one gave a history of blackwater fever.

The results of our blood examinations in the township showed that all three species of the malaria parasites are being transmitted in

Kampala at present, but that, at the moment, there are more infections with the benign tertian species (*P. vivax*) than with the malignant tertian (*P. falciparum*) and quartan (*P. malariae*).

As regards mosquitoes, Mr. Hancock, before my arrival, had made a preliminary survey of breeding places of anopheles in some parts of the town. We extended these observations during my visit and also caught and dissected adult specimens of *A. costalis* and *A. funestus* found in native huts. In the short time available we were able to dissect only a very few specimens; it is therefore important as indicating a probable high rate of malarial infection in these insects that we found the salivary glands of one specimen of *A. funestus* to be heavily charged with the sporozoites of the malaria parasite.

4. It is justifiable to infer from the observations just mentioned that there is a surprisingly high incidence of endemic malaria in the Kampala township and that the risk to European and other residents is serious. I suppose that the risk will increase towards the middle of the year.

5. In view of these findings I consider that it is of primary importance to obtain as soon as possible fuller information of the conditions and circumstances governing the malarial situation in the town and to continue to collect this information systematically week by week and month by month from now onwards. I recommend that the following organisation for this inquiry be established forthwith:—

1 medical officer as “Malaria Officer.” If possible he should be a selected medical officer who has had previous special training and experience in malaria work.

1 medical entomologist. Until this officer can be obtained I beg that the services of Mr. Hancock may continue to be placed at our disposal for this work.

1 European laboratory assistant. Mr. Gibbins has been lent to me during my visit and has already become acquainted with the particular technical methods used for the dissection of mosquitoes as well as the supervision of boys engaged in searching for anopheles in houses, etc. He is expert at blood examination work and I hope very much that his services will be retained in the group; he bids fair to become a valuable member of a permanent malaria survey section.

1 native surveyor able to make detailed maps of selected areas, take levels, etc.

1 African student trained at Makerere College (I hope it may be proved that this class of assistant will prove valuable and economical).

8 native “boys” as searchers of larvæ and adult insects.

I recommend that for the present this group be organised as a “local Malaria Survey Unit” with headquarters and laboratory

accommodation at the Clinical Laboratory of the Division of Laboratory Services, and that it be provided out of the Kampala antimalarial allotment with all equipment necessary for making complete malaria and mosquito surveys. I have discussed details of equipment with Dr. Chell and Mr. Hancock. The Unit should be a new organisation, its cadre being additional to the present sanctioned strength of the Medical Department.

6. The Officer-in-Charge of the Unit ("Malaria Officer") should arrange to establish 6 "observation stations" (or more as the work progresses) in selected areas of Kampala. I have discussed with Mr. Hancock the details of the work to be done in connection with these stations prior to my return in June.

7. A sum of, say, £150 should be made available for incidental expenses relative to the inquiry and for experimental measures and research of different kinds which will be required during the course of the inquiry and observational work. It is essential that there should be no delay in obtaining sanction for expenses necessary to conduct experiments on practical measures and on the life history and habits of the malaria-carrying insects. I have discussed this matter with Dr. Chell.

8. It will be necessary to require the European staff of the Unit to travel to and from the observation stations by motor car or motor bicycle in order to save time and energy (the task of searching houses and breeding places is very arduous) and in order that the area of observation may be extended as far as possible.

9. It should be understood that the Local Unit will continue their observations in Kampala throughout the period during which engineering and other antimalarial works are being conducted there, and that thereafter they will form the nucleus of a "Central Malaria Survey Unit" which will work in any part of the country.

10. In addition to routine observational work, the Local Unit will be occupied with important investigation of a practical nature immediately concerned with the Kampala antimalaria campaign, Investigation and practical trial of the use and efficiency of "Paris Green" as a larvicide must be one of these subjects of inquiry, and another might well be experimental trial of afforestation of a swamp area as a substitute for subsoil drainage. On this subject Mr. Hancock and I have spoken with Mr. Templer, of the Forest Service, and have provisionally selected a site (the Lugogo swamp) where planting with eucalyptus might be tried after thorough survey by the Unit of breeding places and degree of water-logging, etc. On account of the great expense of modern antimalaria subsoil drainage I consider that it is highly desirable to test the efficacy of afforestation of a swamp area in Kampala, and I therefore recommend that arrangements be made as soon as possible to plant the selected Lugogo site.

It is an area of about 60 acres and I understand that the cost of planting it with eucalyptus should not exceed £5 per acre.

11. On the subject of subsoil drainage I must also mention the suggestion which I made to you this morning to obtain the advice of Mr. Bennett, the antimalarial engineer who is at present engaged in the subsoil drainage of swamp areas in Nairobi. Neither the sewerage system nor the storm water drainage system to be designed by the engineers who are coming from England will be concerned with the drying of swamps, hillside springs and some other kinds of surface outcropping water in which malaria-carrying mosquitoes breed, nor (as I suppose) will they be concerned with training and otherwise making harmless the streams and ditches which surround Kampala. I think Mr. Bennett's advice on these matters would be valuable, and I therefore recommend that the Kenya Government be asked to lend his services for the purposes. Perhaps, in the first place, it would be sufficient to ask that he might have a preliminary consultation with me in Kampala, when I return in June, before the arrival of the engineers from England.

12. I have already mentioned in paragraph 10 the kind of research of immediate practical utility which the Local Survey Unit will do in addition to routine observational work. I think it is very desirable, in addition to this local investigation, to arrange as soon as possible for continuous research on subjects relevant to the epidemiology of malaria in Uganda as a whole and the life history and habits of the malaria-carrying anopheles of the country. For example, it is of great importance to ascertain whether some of the anopheles of the country other than *costalis* and *funestus* are capable of transmitting the disease,* and if so to what degree, as also to ascertain in detail the habits of the known carrying species (*funestus* and *costalis*) with regard to length of life of the adult stage, duration of stay in houses, selection of breeding places, habits with regard to egg-laying, larval ecology and other points from which indications of the best methods of attacking these insects can be obtained. Officers qualified to conduct this kind of research should be recruited separately on temporary or permanent agreement irrespective of age and other usual civil service limitations, which experienced research workers are seldom able to fulfil. The work should be done at the present institute at Entebbe, rooms and equipment being set aside to form a malaria section of the Institute. It is essential to employ the best men available for this kind of research in order that the section may become known in the scientific world and may attract more and more workers. Therefore it will probably be necessary to offer relatively high salaries to the two or three specialists who are first engaged."

I was accompanied, on my second visit, by Mr. Bennett, the anti-malarial engineer mentioned in paragraph 11 of my memorandum to the Chief Secretary, and by Mr. Hopkins, medical entomologist, Kenya, who had been offered and had accepted the post of medical entomologist, Uganda. A "malaria officer" (Dr. McLeod) and the

*e.g. *theileri* (see page 37).

group of workers asked for in paragraph 5 of the memorandum* had been appointed and were continuing the work begun during my first visit. In native huts of the five "observation stations" which I had selected with Mr. Hancock in different parts of the township, adult anopheles were being caught daily, and during the last half of May about 500 of them were dissected by Mr. Gibbins after being kept alive long enough to free their stomachs from blood. He had made permanent preparations of stomachs and glands which were found to be infected, so that during my visit I was able to confirm the results which were briefly as follows. Identification of species caught and dissected was made by Mr. Hancock.

1. Number of adult anopheles caught in huts at the observation stations during May :—

Observation Stations.	Costalis.	Funestus.	Theileri.	Other Species.
A. (4 huts) ...	77	3	—	1
B. (4 huts) ...	132	13	39	—
C. (4 huts) ...	21	—	—	—
D. (4 huts) ...	175	134	—	—
E. (3 huts) ...	165	19	—	—
	570	169	39	1

2. Results of mosquito dissections :—

Species.	No. of stomachs examined.	No. of stomachs with zygotes.	No. of glands examined.	No. of glands with sporozoites.
Costalis ...	355	37	119	7
Funestus ...	121	16	36	1
Theileri ...	33	—	31	—
	509	53	186	8

According to these results the infection rate of anopheles caught within the township during the month of May is very high (zygote infection 10 per cent.; sporozoite infection 4·3 per cent.). It confirms the view expressed in my first memorandum that European, Asiatic and other residents in Kampala township run a serious risk of contracting malaria. It is to be noted that both *costalis* and *funestus* are incriminated as proved malaria carriers in the town, and that a moderate number of specimens of a third species (*theileri*) were caught in native huts at one of the observation stations.

Mr. Hopkins took over from Mr. Hancock the entomological duties for which the latter officer had been lent by the Agricultural Department. Mr. Bennett got into touch with the Departments of Public Works and of Forests, and after a thorough examination of the town

* Except a native surveyor; a suitable man for this post had not been found at the time of my second visit.

in company with officers of those Departments, prepared the following report which was forwarded on the 18th June to the Chief Secretary to Government through the Director of Public Works, Kenya :—

PUBLIC WORKS DEPARTMENT,

HEAD OFFICE,

NAIROBI,

18th June, 1929.

To the HON. THE DIRECTOR OF PUBLIC WORKS.

ANTIMALARIAL DRAINAGE OF KAMPALA MUNICIPALITY.

SIR,

I have the honour to report on the antimalarial drainage for Kampala Municipality to protect the town, hospitals and main residential quarters.

2. The area I have taken as adequate for this purpose is roughly a half-mile radius from the more thickly populated areas.

3. On the map* annexed to this report the swamp land is coloured red and the municipal boundary edged blue.

4. The town is built on a series of hills between which there are gullies, all, with one exception, running due north or south into a large papyrus swamp connecting with the lake at Port Bell, about six miles from Kampala. The other gully runs north away from the town and affects the Mulago hospital and the technical school areas.

5. These gullies and the main swamp as far as the P.W.D. brick-fields are under native cultivation. They have earth channels varying from 4 feet to 6 feet deep along the centre of the gullies to convey spring and storm water. As only the larger springs have been tapped, considerable seepage is taking place on the sides of these channels along the whole length. Wells have been dug for native water supplies and no doubt also for irrigation to some extent.

6. To dry up these swamps it is necessary to catch all the spring water which seeps out at the toe of the slopes, and this can be accomplished in two ways :—

(a) By sub-soil drainage.

(b) By planting eucalyptus trees.

7. The first method will always require very careful attention and maintenance, whereas the second method will, in the course of time, pay for itself and require practically no maintenance.

8. I strongly recommend adoption of the second method which has already been tried by the Forest Department in swampy land near Kampala with astonishingly good results.

* Not printed.

9. No matter what method is adopted it is, in my opinion, essential that all cultivation, unless under very strict control, should be abolished within the area to be protected, and no open pools, wells or borrow pits of any description be permitted.

10. There are brickfields in active operation at four points in the Nakiyubo swamp marked W.X.Y.Z. on the plan. These areas will require levelling and filling, several holes being already too deep to drain.

11. The points marked A.B.C.D.E. are places selected by Colonel James for observation to ascertain the numbers and types of mosquitoes breeding in Kampala and the amount of infection in the different areas.

12. The total acreage in the ravines (area coloured red) amounts to nearly 500 acres, and for the purposes of an estimate I am taking that figure.

Method (a)—By sub-soil drainage.

13. Sub-soil pipes 4-inch diameter should be laid along the toe of the ravine slopes and connected at intervals to the main central channel. They should be laid true to grade at a depth not less than 5 feet from the surface, should be butt-ended and pressed up as close as possible to each other. All trees of any description must be cut down and stumps removed. The estimated cost of this is £30 per acre.

500 acres at £30 = £15,000.

This amount includes concrete drains down the centre of the ravines to carry the spring water, and sloping and turfing the sides of the drain above the concrete invert.

Maintenance will cost about 4 per cent. annually, i.e., £600.

Method (b)—By planting eucalyptus trees.

14. These should be planted at 6 ft. spacing. When the trees are ready for felling, alternate rows should be cut down, so as to leave the others to take up the seepage water.

These should cost £5 per acre.

500 acres at £5 = £2,500.

Maintenance will cost about Sh. 20 per acre for the first year, decreasing by Sh. 5 per annum, till by the fifth year there should be very little maintenance. The trees are valuable and revenue derived from them should give a good return on the outlay.

15. In the course of time the trees will use up the major portion of the spring water, and perhaps all of it. I therefore recommend that the central channel be left as an earth drain. This will require periodical oiling, but if the invert of the channel is cut in the clay, carefully graded and kept narrow, the water should always be running

and breeding of larvae should not take place, with reasonable attention to seepage and footprints. If a concrete channel is found eventually to be required, it will only be a small one.

16. I have not estimated for the filling and levelling required in the brickfield areas. This should not be expensive as in most cases a little levelling of the moulds is all that is required.

17. At the top end of R. Kitante (observation stations B and C) the land is under cultivation by the Agricultural Department for experimental purposes. If it is proposed to retain this for experimental purposes, it will require sub-soil draining and an open concrete channel down to the Nakivubo swamp. This will cost about £2,500.

I have the honour to be,

Sir,

Your obedient Servant,

(Sgd.) H. BENNETT.

Before my departure from East Africa I reported by letter to the Acting Director of Medical and Sanitary Services, Uganda, that I agree wholly with Mr. Bennett's recommendations and that for various reasons I consider that for the purpose of drying the ravine slopes and swamps, method (b), planting eucalyptus trees, is to be preferred to method (a), sub-soil drainage.

It is immensely important, of course, to adopt and to comply strictly with Mr. Bennett's recommendation No. 9 that cultivation of food products (sugar cane, maize, bananas, rice, potatoes and other vegetables, etc.) should be entirely abolished within the area to be protected, and that no open pools, "wells" or borrow pits of any description should be permitted. Unless this matter can be dealt with firmly and finally now, Kampala will be faced in the near future with even greater difficulties and expense than those with which Nairobi has been endeavouring to cope (as yet unsuccessfully) for a number of years. Areas occupied by native "squatters" may have to be acquired in the public interest as a charge against Town Planning, and new legislation may have to be introduced and strictly enforced. In this connection it may be useful to reproduce here the provisions of Section 157 (1) of the Public Health Ordinance of Kenya which provides that:—

"When it is shown to the satisfaction of the Governor in Council upon the advice of the Central Board of Health that the growing of any crops, or the irrigation of any land, being within the boundaries of a township or within three miles of such boundaries, is unhealthful or insanitary, the Governor in Council may, by order published in the Gazette, prohibit the growing of any crop or the irrigation of any land within any area, within the boundaries of a township, or within three miles of such boundaries, and may cause any permit or authorisation issued for the

diversion, abstraction or use of water for such purpose to be cancelled upon such terms as may appear to him equitable."

I may note also that in Kenya the "Select Committee on Draft Estimates, 1929," recommended that draft legislation on the following lines be introduced into the Legislative Council immediately:—

"The proper course of action is for the Government to take power in the interests of public health to prevent the owner or leaseholder of land in townships from having on such land places in which mosquitoes may breed; to introduce legislation providing that proper and adequate steps shall be taken by the owner or leaseholder to remove such potential breeding places from such land to the satisfaction of the Local Authority, and, in default of his doing so within a specified time, to take power by which the Government or its agent, when duly authorised, may enter on the land, carry out the necessary work and charge the owner or leaseholder with the cost; and making provision that compensation, when payable, should be assessed in accordance with the terms of a law and should not be left to be determined by the Governor in Council as is the case at present under the Public Health Ordinance."

The brickfield mentioned by Mr. Bennett and any others should be abolished and the ground filled and levelled, and in future no brickfield should be permitted within three miles of the township boundary.

It will be a duty of the "local Malaria Unit" as well as of the Medical Officer of Health to draw attention to all breeding places of malaria-carrying mosquitoes and to make regular inspections to ascertain the effect of measures on the incidence of those mosquitoes and of malaria, but it should not be part of the Unit's duty to obliterate or otherwise to deal with breeding places, as their whole time should be more profitably occupied in investigation work.

TOUR IN THE EASTERN PROVINCE.

From the 9th to the 13th June I toured in the Eastern Province of Uganda with Dr. Chell, Acting Director, Medical and Sanitary Services. We visited Masindi, Lira, Siroti, Mbale and Tororo. All are so malarious that the disease among the indigenous inhabitants is chiefly a disease of the age-group 0 to 5 years; most of those who live to be six or more years of age have acquired immunity. We examined in all 127 very young African children (from 2 or 3 months to 5 years) and 140 older children and adults. The spleen-rate in the former group was 65 per cent., in the latter 6 per cent.; and the parasite-rate changed in the same manner. Tororo was the place with the highest indices of malarial endemicity, the parasite-rate among African babies and children under five years being 80 per cent. and the spleen-rate 96 per cent. At this period of the year (June) the malignant tertian (subtertian) parasite prevailed, but earlier in the year (April) I had found the quartan parasite to be frequent.

I have already noted on page 20 the great prevalence of anopheles mosquitoes at Tororo, but they were numerous at all the places in Uganda which we visited. The houses of all Government officials and private residents are screened, but this did not prevent us from catching specimens in all the houses where we stayed, and I noted that medical officers and their wives and children invariably wore mosquito boots and slept under mosquito nets in the screened houses. Dr. Chell never failed to collect ten or more specimens of *costalis* every morning from the inside of the verandah netting, and we found many more under the eaves outside. Some of the reasons for finding anopheles inside these houses are obvious and should be corrected without delay. They seemed to me to be due to failure on the part of contractors who build the houses to obtain local expert advice from the Public Works or the Medical Department, or perhaps to failure to follow that advice if it were obtained. The truth is that these houses are not effectively screened; often the back verandah is left without any screening at all, and I have not yet seen a house in which the passage from the back door of the house to the kitchen is screened. The back doors of the house nearly always fit badly; it is much easier for servants to leave them partly open than to close them on the latch. Unseasoned wood is used; it warps and shrinks so that, after the house has been standing a few months, there is nearly always an open space an inch or more wide under or above each outside door. There are many other details which could best be demonstrated to an intelligent builder-foreman on the spot. No one who has seen anopheles mosquitoes resting under the projecting eaves over the door of a house, or flying up and down against the verandah netting, searching a hole of entry, can doubt the importance of details which builders are too apt to regard as trivial.

Siroti is an example of a community in which houses for Europeans are much too close to native huts, African police lines, the prison and the bazaar. One result is that although the parasite index of malarial endemicity among African children was lower than in other places visited, Europeans in certain houses were reported to suffer from malaria very frequently and severely. The siting of houses for Europeans is, of course, by far the most important matter to be considered in connection with the prevention of malaria among them.

At Mbale we examined carefully the excellent arrangements originally designed and executed by Dr. McIlroy for surface drainage by open earth ditches and for their maintenance and oiling under arrangements now personally supervised by the Sanitary Inspector of the township (Mr. Wazir Singh). Here we stayed at the Dak bungalow, and next morning, as usual, caught specimens of *costalis* on the inside of the verandah screening. The spleen rate of African children under five years of age examined in the native village was 70 per cent., but of those of ages between six and thirteen it was only 25 per cent.

CONCLUDING RECOMMENDATION.

(Applicable to Kenya, Uganda and Tanganyika.)

I have recommended that a new organisation be created in Kenya and a new organisation in Uganda for the purpose of assisting the authorities to put into effect the antimalarial policy and action advised in this report, and of continuing and extending the lines of work in the field and laboratory which were begun during my visit. These organisations are to be composed of trained workers who are intimately acquainted with local conditions and peculiarities and are in close touch with similar organisations in other countries and (most important of all) with the government medical officers, public health workers and private practitioners in their own countries who have to deal with malaria. It will be their aim and duty "to work out the salvation" of the country as a whole, and of particular localities, in the problem of choosing and conducting particular methods of malaria control. For the final solution of this problem experimental measures based on continuous research will be necessary; and there can be no doubt that the requisite routine observational work, and research of immediate practical utility, will occupy the whole time of every member of the small organisations asked for. But, if malaria is to be controlled scientifically, there is much else to be done. In paragraph 12 of my memorandum to the Honourable the Chief Secretary to the Government of Uganda (page 36 of this report), I mentioned a few malaria problems which await solution; and there are many more. One of them is to ascertain what is the effect of endemic malaria on the indigenous natives of the country. At present, on this subject, no definite knowledge derived from careful and prolonged local observation is available. At Taveta we began to study it during my tour by taking temperatures, estimating the hæmoglobin content of the blood, and making other clinical observations on infants, children and adults in whose blood we found large numbers of malaria parasites; but, obviously, what is needed is continuous enquiry accompanied by an adequate arrangement for recording vital statistics during a period of not less than a year in a stabilized community resident in that or another malarious place. Then there is the problem of adult immunity to malaria. Are we to recommend that farmers, the Railway and the Public Works Department should recruit their labour from tribes whose adult members are already immune to malaria, and, if they do so, will the immunity persist in the labourers' new surroundings? Also, if they employ non-immune labour (as was done in German East Africa during the War) what special anti-malarial precautions must be taken—because the terrible results of cerebral malaria and blackwater fever among those non-immune natives during the War are still fresh in our minds, and the same disaster may happen again in any "epidemic year." Again, there is the problem of how best to treat malaria by quinine, and how best to use quinine "prophylactically," if indeed it is wise to use it at all for this purpose. I referred to this subject in my address to members of

the Kenya branch of the British Medical Association at Nairobi in May; it was evidently a matter to which very high importance was attached by government medical officers and private practitioners. Half-a-dozen other subjects of immediate practical importance which urgently call for enquiry could be enumerated.

What are we to do about all these problems? Obviously they cannot be tackled effectively by directors or assistant directors of fixed laboratories because most of them require uninterrupted study "in the field" in villages and rural areas where the disease is rife, and those officers are tied to their laboratories in the big towns and are already overburdened with routine duties and with giving necessary laboratory assistance to hospitals and practitioners. Nor can they be studied satisfactorily by the small special organisations which I have recommended for Kenya and Uganda because, as has been noted above, the allotted task of every member of those organisations will occupy his whole time.

There is a glimmer of hope in the knowledge that practically all the problems just mentioned, as well as those named in my memorandum to Uganda, are subjects of interest not only to each territory but to East Africa as a whole. Perhaps no territory by itself could afford to employ a group of workers solely for those problems, but if each territory would contribute to a joint fund for such a purpose and if it were agreed that the fund would be spent on men, not on buildings, and that the work would be done in whichever territory or locality it could best be done, irrespective of geographical or political boundaries, then it seems to me that a recommendation for steps to be taken to solve those problems is reasonable. In this connection I take leave again to draw attention to the "suggestion concerning arrangements for medical research in East Africa," which is annexed as Appendix 2 of this report. The creation of the proposed fund should not in any way hinder the establishment or development of permanent fixed laboratories which, like hospitals, are an essential part of the medical arrangements of every country. Those fixed laboratories, their scientific equipment, and the highly trained government bacteriologists and other specialists who staff them, constitute the permanent "framework" of the country's scientific medical organisation; and all that is implied in my note (Appendix 2) is that this framework should now be supplemented and made use of by an elastically administered organisation constituted so as to facilitate the conduct of medical research on the best lines throughout East Africa. Malaria is chosen as the subject with which the proposed fund could most profitably initiate its activities because it is incomparably more important to master malaria than any other East African disease; but the research financed by the fund would not be confined to malaria; it would in time be concerned with the whole field of special medical research, and, as has happened in India, it would attract and stimulate private practitioners, chemists, botanists, entomologists and other qualified official and unofficial workers to occupy themselves with

special lines of investigation in connection with preventive and curative practice.

I suggest that the Governments of Kenya, Uganda and Tanganyika should arrange to make an annual grant of £5,000 each for the establishment of the proposed "East African Medical Research Fund" and that, when this has been agreed to, the aims and objects of the fund should be brought to the notice of commercial firms, companies and individuals interested in the development of those countries with a view to their becoming subscribers or donors to the Fund with the right to take part in the transactions relating to its disposal.

APPENDIX 1.

ITINERARY.

DATES, 1929.	PLACE.	LOCAL VISITS.
March 5th ...	Left London ...	—
March 25th & 26th	Mombasa ...	The town and port; the native hospital.
March 27th to April 3rd.	Nairobi ...	The town and suburbs; Medical Research Laboratory; Veterinary Research Laboratory; coffee estates; seisal estate; Ngani; Kiambu; Thika.
April 4th & 5th...	Nakuru ...	The town and district; the native hospital; farms in "settled areas."
April 6th to 9th...	Eldoret ...	The town and suburbs; the European school; the native hospital; native locations; labour lines; police lines.
April 9th ...	Hoey's Bridge ...	Three farms in "settled areas."
April 10th to 18th	Kitale ...	The town; European school; native location; P.W.D. lines and brickfields; six farms in "settled areas"; established observation station A.
April 19th to May 1st.	In Uganda ...	Tororo; Kampala; Entebbe; Lake Nyanza.
May 2nd to 4th...	Kisumu ...	The town and suburbs; the Kano Plain; Gweya boma; native reserve; Nyaheri village; Masena village.
May 6th to 13th	Nairobi ...	—
May 14th & 15th	Voi ...	Railway staff lines; seisal estate; native village.
May 16th to 21st	Taveta ...	Established observation station B; Mission village; native reserve; two farms; Kidoghoto; Lakes Gipi and Chalu.
May 23rd ...	Nairobi ...	—
May 25th ...	Eldoret ...	Farms and B.W.F. cases.
May 26th to 30th	Kitale ...	Observation station and farms in "settled areas."
May 31st to June 3rd.	Nairobi ...	—
June 4th to 14th	In Uganda ...	Entebbe; Kampala; Masindi; Lira; Siroti; Mbale; Tororo.
June 15th ...	Nairobi ...	—
June 18th & 19th	Mombasa ...	The Digo district.
June 20th ...	Tanga (Tanganyika)	The hospital; drainage of swamps; the prison.
June 22nd ...	Dar-es-Salaam (Tanganyika)	Hospitals and native town; the prison.
June 26th ...	Beira ...	—
June 28th to July 1st.	Salisbury (South- ern Rhodesia).	European farms.
July 6th to 9th ...	Capetown ...	European farms.
July 30th ...	Disembarked London.	—

APPENDIX 2.

A SUGGESTION CONCERNING ARRANGEMENTS FOR MEDICAL RESEARCH IN EAST AFRICA.

(NOTE.—*Prepared for a meeting of the Governors of Kenya, Uganda and Tanganyika and Sir Samuel Wilson at Nairobi on 1st June.*)

Permanent medical arrangements in a tropical country are organised in the first place by establishing :—

- (1) A Government service of physicians and surgeons.
- (2) Hospitals and dispensaries in which these officers work.
- (3) A laboratory service to assist them in diagnosis and to prepare curative and preventive vaccines and sera.

Until these services have been working for some years, the question of an arrangement for medical research does not often arise. When it arises (usually on the occurrence of a severe epidemic disease about which little or nothing is known) the first plan usually adopted is to assign the necessary enquiries to the existing medical and laboratory staff. This *ad hoc* action can seldom be avoided, but it has the disadvantage that, ever afterwards, research is regarded as one of the everyday duties of the existing laboratory staff. It delays for a long time an understanding of the truth that research requires an organisation additional to, and separate from, existing arrangements. Fortunately to-day this truth is not questioned in any country with experience of the futility of adding research to the duties of existing services. Therefore, at present, in most countries, the only difficulty is to arrange for this separate research service. The difficulty is usually lack of funds, but, even in some very poor countries, this difficulty has been overcome when administrators are convinced of the desirability of doing so. India is a notable example and I take leave to bring to notice the plan adopted some twenty years ago in that country, in the hope that it may now be repeated in East Africa.

India, at that period, possessed several large bacteriological institutes and a separate bacteriological department to staff them. These were increased as time went on, and it was hoped that they would serve the needs of the country for research work, as well as for routine duties and the preparation of vaccines and sera. It was found, however, that, in an institute, the routine work of the province, and even of the town, in which the institute is situated, soon absorb the whole time of the staff, which consequently becomes tied to the institute and unable to conduct research into the epidemic diseases and other primary problems of the country as a whole.

For this reason, it was proposed to the Government of India, in 1911, to start a fund for employing workers whose whole time would be devoted to medical research, particularly into subjects which were regarded as being of "all-India," rather than of local, importance. The fund was to be independent of existing laboratory arrangements and institutes, and was to be free from departmental control. It was to be placed in the hands of an "Association" to be called the "Indian Research Fund Association" administered by a "governing body" acting on the advice of a "scientific advisory board." Members of the general public, private companies and others were to be invited to become donors or subscribers to the Fund and by doing so they would become members of the Association with the right to attend the annual meetings and to suggest lines of work.

The Government of India accepted the proposal and agreed to start the Fund with an annual contribution of five lakhs of rupees (£33,000).

The Association was very successful and for some years past its annual income has been not less than £65,000 which is devoted entirely to financing and promoting research on medical and allied subjects in different parts of India and Burma. It possesses no research institute of its own, but works in close collaboration with the

Government Bacteriological Department and Institutes, its workers being accommodated either in those government laboratories or in temporary field observation stations and laboratories constructed in the places where the diseases, or other problems of study, occur. By providing additional temporary staff for existing government institutes, it frees the directors and other officers of those institutes from routine work, thus enabling them to take a prominent part in the research work financed by it. It finances researches conducted by government medical officers and bacteriologists, private practitioners, chemists, botanists, entomologists and other official and non-official qualified workers in particular subjects in different parts of India, and it employs specialists from Europe, America and other parts of the world without limitation of nationality, age, or fixed scales of salary. Professor D'Herelle from Egypt, Dr. Bruce Mayne from the United States of America and Professor Assesov from Yugo-Slavia were among the workers employed last year. At present more than 40 special researches are being conducted under its auspices. For some of them (*e.g.*, "The Malaria Survey of India," the "Enquiry into Deficiency Diseases and other Problems of Nutrition" and "Biochemical Enquiries") permanent organisations on a considerable scale have been provided by the Fund. The results of enquiries are published, as a rule, in the "Indian Journal of Medical Research" which is financed by the Association. There is also an annual conference of research workers from all parts of India held by the Association at which there is an exchange of views on subjects of work and at which new lines of activity are suggested and discussed.

The Association is essentially a Government organisation, for the Government of India contributes the bulk of its funds and it is run entirely by administrative and technical officers of the Government of India and of local governments. But it is essentially, also, a free voluntary organisation, for there is general agreement that its administration shall not be hampered or embarrassed by departmental control, and all the work which highly placed officials of the Government of India put into it, is done unofficially. Partly to avoid embarrassing regulations, it has been decided not to register the "Association" under the Companies' Acts.

The Governing Body of the Association includes:—

President.—The Hon. Member for Education, Health and Lands in the Governor General's Council.

Members.—The Chief Secretary to Government in the Ministry of Education, Health and Lands, the Director General, Indian Medical Services, and the Public Health Commissioner with the Government of India.

The Scientific Advisory Board includes among its membership the directors of each of the central and provincial bacteriological institutes in India and some non-official scientists of European reputation. The Public Health Commissioner with the Government of India is Secretary of this Board and at present he also acts, in collaboration with the Under-Secretary to the Government of India in the Ministry of Education, Health and Lands, as Secretary to the Governing Body.

Proposals for research are put up at the annual meeting of the Scientific Advisory Board. Approved schemes are passed at the annual meeting of the Governing Body. The work is then begun forthwith.

My suggestion is that, when a High Commissioner for East Africa is appointed, he should initiate, in collaboration with the Governors of each of the three territories concerned, an "East African Medical Research Fund" of this kind. If it should happen that the appointment of a High Commissioner is disapproved, or is greatly delayed, I suggest that the three Governors should collaborate to introduce the plan. I think it probable that, if this Fund were started by a grant from each of the territories, suitable application to private individuals and trading companies interested in the health and economic prosperity of these countries would yield a sufficient income to place medical research in East Africa on a sound basis. The results could not fail to benefit the country greatly.

(Sgd.) S. P. JAMES.

NAIROBI,

May 31st, 1929.



